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Biological Notes on *Hyperaspis asiatica* (Coleoptera, Coccinellidae)

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Abstract The bionomics of *Hyperaspis asiatica* (CROTCH) (Coleoptera, Coccinellidae) were surveyed at the estuary of the Onosato River, Osaka Prefecture, Central Japan. This species emerges between May and July and appears to prey on the nymphs of the scale insect *Orthezia yasushii* KUWANA (Homoptera, Ortheziidae) on the Japanese mugwort *Artemisia indica* var. *maximowiczii*. The last instar larva of the beetle has a white coating of waxy threads and pupates in its own larval exuvia. The eclosed adult hides in its own pupal exuvia surrounded with larval exuvia for 3–4 days and then emerges outside. These remarkable habits may be advantageous to escape attacks by ants attending *O. yasushii* for the honeydew and other predators.

Introduction

Hyperaspsis DEJEAN is a small coccinellid genus for the Japanese fauna, while North America harbors ca. 170 species of *Hyperaspis* (SASAJI, 1998). Of the five *Hyperaspis* species in Japan, *H. japonica* (CROTCH) is a common species whose biology is relatively known. *Hyperaspis japonica* is a beneficial insect attacking mealybugs, the Pseudococcidae (Homoptera) (SASAJI, 1985). However, the bionomics of four other *Hyperaspis* species are poorly known. *Hyperaspis asiatica* LEWIS is a relatively rare species and its biological information is scarce; immature stages and the prey insect of *H. asiatica* have not been reported. Life history characteristics of coccinellid beetles (*e.g.*, food items, wax-producing habits in larvae, and pupation in or without larval exuviae) are well-fixed traits in phylogenetic relationships (POPE, 1979; MAJERUS & KEARNS, 1989; HODEK & HONEK, 1996; SASAJI, 1998). Therefore, accumulating life history information would not only be useful for coccinellid ecology but would also give phylogenetic implications. We observed the life history of *H. asiatica* at a small estuary in Central Japan. This paper reports the bionomic aspects of *H. asiatica* such as habitat association, immature stages and prey insect.

Study Site and Methods

Field observations and samplings were carried out on the riverbank (34°22′N, 135°15′E, 2 m above sea level) of the Onosato River, Sennan City, Osaka Prefecture, Central Japan. The study site was located at the estuary of the river (Fig. 1) within 500 m from the sea (Osaka Bay). The riverbank was vegetated with the wild rose *Rosa wichuraiana*, the Chinese elm *Ulumus parvifolia*, the common reed *Phragmites communis*, the Japanese mugwort *Artemisia indica* var. *maximowiczii*, the fireweed *Senecio madagascariensis* and so on.

We found an adult *H. asiatica* on a leaflet of the wild rose on 9 May, 2002, when the bionomic study of the beetle was first addressed. We established a 300 m transect along the right rivberbank, and the senior author searched for these beetles (both larvae and adults) on various vegetation monthly for about one hour per search day from May to November, 2002, noticing colonies of aphids and scale insects. The collected larvae were reared with potential host insects in 200 ml plastic cups in the laboratory. Prior to the regular investigation the senior author had surveyed the insect fauna along the transect on 5 April, 2002.

Results

Seasonality and host insect

Hyperaspis asiatica was found between May and July as adults and in June and July as larvae at the study site, but neither adults nor larvae of the coccinellid were found in April or between August and November (Table 1). Excluding one adult found on a leaflet of the wild rose in May, all adults and larvae were observed in the colonies of the scale insect *Orthezia yasushii* KUWANA (Homoptera, Ortheziidae) on *A. indica* var. *maximowiczii* (Fig. 2). Although many aphids such as *Macrosiphoniella yomogicola* (MATSUMURA) on *A. indica* var. *maximowiczii* and *Uroleucon nigrotuberculatum* (OLIVER) on the goldenrod *Solidago altissima* occurred on various plants during spring and autumn, *H. asiatica* was not found on those plants. On *A. indica* var. *maxi-*

Table 1. Seasonal occurrences of *Hyperaspis asiatica* and its host *Orthezia yasushii* at the estuary of the Onosato River, Central Japan in 2002. For *H. asiatica* and *O. yasushii*, no. of individuals and presence/absence data are respectively presented. −: none found, +: found, ++: abundantly found.

	Developmental stages	Dates							
		5 Apr.*	9 May	6 June	3 July	12 Aug.	3 Sept.	4 Oct.	7 Nov.
H. asiatica	Adults	0	1	2	1	0	0	0	0
	Larvae	0	0	1	3	0	0	0	0
O. yasushii	Female adults	−	+	++	+	+	−	−	−
	Early-instar nymphs	−	−	++	++	+	−	−	−

* Casual faunal survey.

mowiczii, *H. asiatica* coexisted with other coccinellid species, *Scymnus hoffmanni* WEISE and *Brumoides ohtai* MIYATAKE, but whether these coccinellids except *H. asiatica* preyed on *O. yasushii* was unclear. Female adults of *O. yasushii* emerged between May and August and its early-instar nymphs between June and August abundantly on *A. indica* var. *maximowiczii* and with low density on *S. altissima* (Table 1). In June and July, early instar nymphs of *O. yasushii* (body length: ca. 1 mm) were abundant on the underside of host leaves, and both adults and larvae of *H. asiatica* appeared to prey on the nymphs. The body length of the last instar larvae of *H. asiatica* was 3.7–4.6 mm (N=3). The larvae had a white coating of waxy threads (Fig. 2). The ants *Lasius japonicus* SANTSCHI and *Pristomyrmex pungens* MAYR attended *O. yasushii* for the honeydew it exuded.

Habits in pupation and eclosion

A larva collected on 6 June and two larvae collected on 3 July were brought to our laboratories and reared with *O. yasushii* nymphs under laboratory conditions. The coccinellid larva collected on 6 June pupated on 17 June on the underside of an *A. indica* var. *maximowiczii* leaf (Fig. 3) and eclosed on 26 June. The two larvae collected on 3 July emerged as adults in late July. These reared larvae appeared to prey on *O. yasushii* nymphs to complete their growth, although we have not yet observed *H. asiatica* larvae feeding on *O. yasushii* nymphs either in the field or in the laboratory. The larva pupated in its own larval exuvia and the eclosed adult hid in its own pupal exuvia for 3–4 days (Fig. 4) and then emerged outside (Fig. 5). The exposed dorsal part of the pupa had dense bristles.

Fig. 1. Habitat of *Hyperaspis asiatica* at the estuary of the Onosato River, Osaka, Central Japan.

Discussion

Seasonality and host insect

Seasonal occurrence of *H. asiatica* larvae was associated with the emergence of *O. yasushii* nymphs (Table 1). Both adults and larvae appeared to feed on early-instar *O. yasushii* nymphs. Since *O. yasushii* is known to bear a univoltine life cycle (KAWAI, 1980), the reproductive period of *H. asiatica* may be confined to the emergence period of early-instar *O. yasushii* nymphs. However, to determine if this species is a specialized predator of *O. yasushii* or not, more studies are required at various locations. *Hyperaspis desertorum* WEISE is known to feed on *O. urticae* (L.) (Ortheziidae) in Russia (SAVOISKAYA, 1983), though prey menus of most *Hyperaspis* species are the Pseudococcidae (*Pseudococcus* and *Phenacoccus*) (HODEK & HONEK, 1996, p. 174).

Wax production in H. asiatica *larvae*

The larva of *H. asiatica* had a white coating of waxy threads (Fig. 2). Such wax-producing habits are well known in many coccinellid species of the tribes Scymnini, Ortaliini, Hyperaspini (including *Hyperaspis*), Noviini, Coccidulini, Cryptognathini, Azyini, Telsimii and Chilocorini (POPE, 1979). Many wax-producing species feed on scale insects and mealybugs which are also covered with thick wax. Therefore, the resemblance in appearance to host insects may intuitively be advantageous to escape attacks by the ants attending the coccids and mealybugs. In addition, the wax threads are known to be markedly sticky (POPE, 1979). This trait may hinder attacks by ants and other predators. Furthermore, the whiteness of the coccinellid and coccid waxes is an 'insect white'; the color scatter-reflects light in the ultraviolet region as well as throughout the entire visible spectrum. Thus, visually-hunting predators may not discriminate between the coccinellid larvae and the coccids (POPE, 1979). Active coccinellid larvae with wax covering would escape predator attacks in the slow-moving coccid colonies in addition to the dilution effect. These adaptive explanations also appear to apply to *H. asiatica* larvae.

Habits in pupation and eclosion

The last instar larva of *H. asiatica* pupated in its own larval exuvia and the eclosed teneral adult hid in its own pupal exuvia for 3–4 days (Figs. 3, 4). Pupation in its own larval exuvia is relatively common in some coccinellid genera such as *Exochomus* and *Chilocorus* (MAJERUS & KEARNS, 1989). As mentioned above, the wax-covered larval exuviae appear to be useful for the coccinellid pupa to escape attacks by attending ants and other predators. Since the population density of this coccinellid was very low (Table 1), cannibalism by conspecific adults and larvae was not likely. Moreover, the hidden teneral adult may escape from enemy attack by dual protection of larval and pupal exuviae.

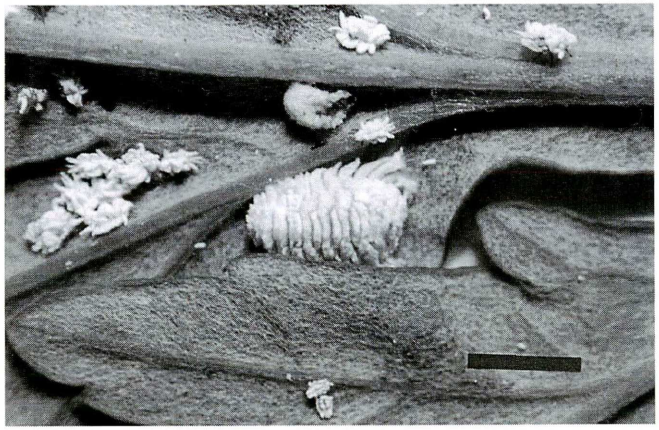

Fig. 2. A *H. asiatica* larva (center) on the underside of an *A. indica* var. *maximowiczii* leaf together with its host *O. yasushii* nymphs (periphery).

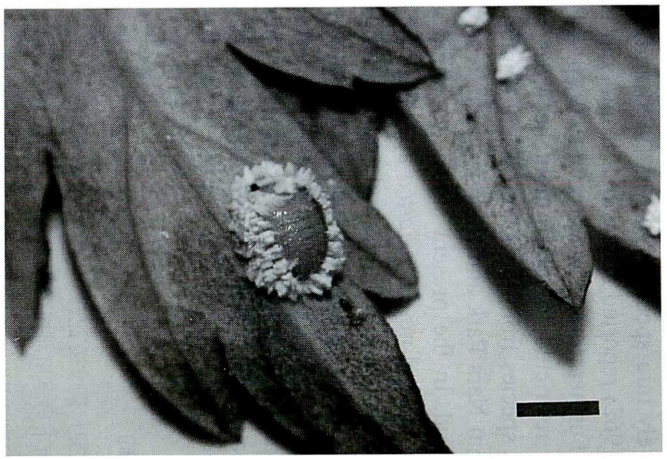

Fig. 3. A *H. asiatica* pupa surrounded with its larval exuvia.

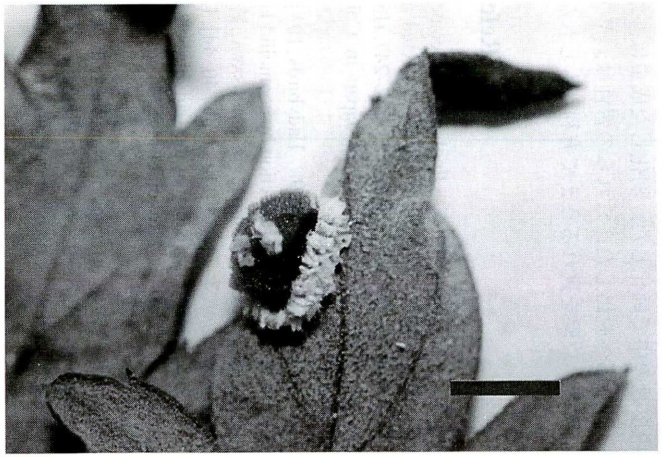

Fig. 4. An eclosed adult of *H. asiatica* hidden in its pupal exuvia.

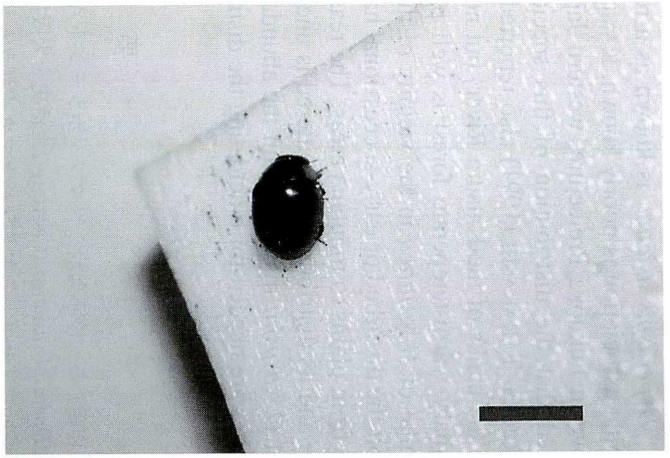

Fig. 5. An emerged adult of *H. asiatica*. Scale bars: 3 mm.

Habitat association in H. asiatica

Hyperaspis asiatica is known as a relatively rare species (SASAJI, 1998) and its habitat association is poorly known. KAMIYA (1962) reported *H. asiatica* from a citrus grove in Fukuoka Prefecture, western Japan. Furthermore, TAKAKURA (1989, p. 44) noted that the distribution of this species is restricted to lower montane areas in Fukuoka. TAKAHASHI (1991) also reported this species from the Kyoto Basin (including the banks of the Katsura River) but not from Nara Park and Kasuga-yama, where primary warm-temperate forest is well preserved. In the present study, we found a habitat of *H. asiatica* in the vicinity of the sea. Therefore, *H. asiatica* appears to inhabit the disturbed or early-successional habitats such as riverbanks and orchards ranging from plains to montane areas. The reason why this coccinellid species is relatively rare and its distribution is scattered is unclear. However, the occurrence of its host insect *O. yasushii* may constrain the abundance and distribution of *H. asiatica*. Further studies are needed for elucidating the distribution and life history of *H. asiatica* in detail.

要　約

山崎一夫・杉浦真治：ツマフタホシテントウの生態に関する記録．—— ツマフタホシテントウ *Hyperaspis asiatica* (CROTCH)の生活史を大阪府泉南市男里川河口で調査した．本種は5–7月に出現し，ヨモギ上のヤスシハカマカイガラムシ *Orthezia yasushii* KUWANA の若齢若虫を捕食していると考えられた．ツマフタホシテントウの終齢幼虫は白色のロウ状物質に覆われ，その幼虫の脱皮殻の中で蛹化した．羽化した成虫は，幼虫の脱皮殻に囲まれた蛹殻の中で数日過ごしてから，外部へ脱出した．これらの習性は，ヤスシハカマカイガラムシに随伴するアリやその他の捕食者の攻撃を逃れるうえで有利かもしれない．

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